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MODIS Validation, Data Merger and Other Activities Accomplished by the SIMBIOS Project: 2002-2003

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Chapter 2

Comparisons of Daily Global Ocean Color Data Sets: MODIS-Terra/Aqua and SeaWiFS

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2.1 INTRODUCTION

To facilitate the SIMBIOS Project ocean-color data merger efforts, MODIS-Terra and MODIS-Aqua daily global ocean products were compared against SeaWiFS data. The analyses focused on assessing temporal biases in MODIS ocean data differences from SeaWiFS and the artifacts present in MODIS data. The artifacts were caused by the difficulties in accurately characterizing this complex sensor for features such as detector-to-detector variabilities, mirror-sidedness, response versus scan angle, and polarization sensitivity. The comparisons were vital for the ocean-color data merger because they enabled extraction of disparate trends and trend dependencies in data between the sensors. One of the goals of the data merger was then to eliminate these trends to produce integrated multi-instrument and multi-year products of a consistent spatial and temporal accuracy and uniform calibration and validation.

2.2 MATCHUP DATA, TIME SERIES, AND STATISTICS

The evaluations of MODIS global data products in comparison with SeaWiFS included qualitative analyses of chlorophyll-*a* and chlorophyll-*a* difference maps from both sensors as well as quantitative analyses. The subsequent results presented here are based on quantitative analyses obtained through sensor data comparisons, called matchups (Kilpatrick *et al*., 2002). Matchups used daily global overlapping level-3 (L3) bin coverage between MODIS and SeaWiFS at 9km resolution. L3 binned files were employed to facilitate comparisons between the sensors of data which corresponded to the same ground location. The 9km bins were used to extract statistically significant global trends in data discrepancies between the instruments averaged over a $9km^2$ coverage and over MODIS multiple detectors. MODIS and SeaWiFS data were processed using up-to-date algorithms, i.e. MODIS-Terra collection number 4, MODIS-Aqua collection number 3, and SeaWiFS reprocessing number 4. MODIS data used in the study were obtained from NASA GSFC Distributed Active Archive Center (GDAAC) and were rebinned from the native 4.6km resolution to 9km bins. SeaWiFS data were acquired at the standard 9km resolution from the SeaWiFS Data Processing System (SDPS).

A time series of daily water-leaving radiance and chlorophyll products, evenly spread over the three years of joint MODIS-Terra and SeaWiFS coverage, was used to study trends in discrepancies between MODIS-Terra and SeaWiFS data. The time series was composed of 74 days, roughly every 15^{th} day, of MODIS-Terra and SeaWiFS acquisitions from February 2000 to December 2002. A time series of MODIS-Aqua and SeaWiFS data was limited to three months of the overlapping sensor coverage. It was composed of 36 days of data, starting with daily and then in 4-day intervals, from the end of November 2002 to the beginning of March 2003. In all investigations only good quality data were applied, i.e. quality 0 MODIS data and standard SeaWiFS L3 quality data. Within the collection 4, MODIS-Terra best-calibrated data spanned the period from November 2000 to September 2001. All MODIS-Aqua collection 3 data were of provisional quality. All SeaWiFS data had a calibrated and validated quality.

Matchup data came from overlapping bin coverage between MODIS and SeaWiFS for each individual day and each common data product. Although both sensors operate using similar spectral bands for ocean applications, only two bands are identical, 412nm and 443nm. These two bands were used to quantitatively compare normalized water-leaving radiances (nLw) between the sensors. Chlorophyll-*a* concentration matchups were performed alongside the nLw comparisons. MODIS chlor_a_2 and SeaWiFS chlor_a products were used which were based on analogous algorithms between the sensors, OC3M and OC4v4 respectively. An example of daily common coverage bins between MODIS-Terra and SeaWiFS and a data scatter plot are displayed in Figure 2.1.